NOTES FOR STUDENTS

Transpiration studies.—An excellent review of recent investigations on transpiration, by KNIGHT,[2] includes the principal contributions for the five years previous to 1916. Conspicuous among the more recent investigations is that by BRIGGS and SHANTZ[3] upon the comparison of evaporation from various types of atmometers and free water surfaces on shallow and deep tanks, with transpiration from alfalfa (*Medicago sativa*). The departure of the hourly evaporation rate of the porous cup atmometers from the hourly transpiration rate of the alfalfa seems to be due largely (1) to the marked increase in the evaporation over transpiration during the night hours; (2) to the more marked response of the atmometers to changes in wind velocity; and (3) to the lack of proportionate response on the part of the atmometers to changes in solar radiation. The departures amount to 90 per cent for the deep tank, 50 per cent for the white cylindrical atmometer, 40 per cent for the brown cylinder, the white sphere, and the Bellani plate, and 17 per cent for the shallow blackened tank, showing no very close correspondence for any of the systems, but decidedly the best approximation in the last mentioned. In such a tank, 91 cm. in diameter and 2.5 cm. high, the water was automatically maintained at a depth of 1 cm.

In view of the divergence of the evaporation rates from the two tanks employed in these experiments, it becomes evident that THOMAS and FERGUSON[4] have not taken into account all the variables in their effort to obtain a law of evaporation from circular surfaces. This was sought primarily for use in standardizing atmometers and other instruments for comparison of water loss with that from the plant in the process of transpiration. Their conclusion that evaporation from a circular water surface is not proportional to its area was already familiar to us, and has been emphasized not only in the investigation cited but also by Livingston.[5]

To facilitate critical studies of transpiration, BLACKMAN and KNIGHT[6] have devised an apparatus for controlling air movements about plants under investigation and have been able to have constant currents up to a speed of 25 m. per minute. Using this apparatus and otherwise securing carefully

[2] KNIGHT, R. C., Recent work on transpiration. New Phytol. **16**:127–139. 1917.

[3] BRIGGS, L. J., and SHANTZ, H. L., Comparison of the hourly evaporation rate of atmometers and free water surfaces with the transpiration rate of *Medicago sativa*. Jour. Agric. Research **9**:277–292. 1917.

[4] THOMAS, NESTA, and FERGUSON, ALLAN, On the reduction of transpiration observations. Ann. Botany **31**:241–255. 1917.

[5] LIVINGSTON, B. E., Atmometry and the porous cup atmometer. Plant World **18**:51–74. 1915.

[6] BLACKMAN, V. H., and KNIGHT, R. C., A method of controlling the rate of air movement in transpiration experiments. Ann. Botany **31**:217–220. 1917.

controlled conditions, KNIGHT[7] has performed experiments with various plants with results which show no close agreement between stomatal opening and rate of transpiration, but which tend to demonstrate that the water content of the leaf is an important factor in controlling its water loss by transpiration, and further that stomatal aperture is not reduced by slight water deficiency in the leaf, but is very sensitive to light changes. On the whole, his results support LIVINGSTON's contention of the regulatory importance of "incipient wilting," and are directly opposed to DARWIN's theory that stomatal aperture plays the primary rôle in the regulation of transpiration.

Working with detatched leaves and with potted plants, MARTIN[8] has confirmed previous conclusions in finding that films of Bordeaux mixture cause decided acceleration in the rates of transpiration, and that their influence is apparent as soon as the spray dries upon the leaves. More recently results of the same nature were obtained by SHIVE and MARTIN,[9] using cobalt chloride paper. The indices of the transpiring power of the sprayed leaves are shown to be rather more than 20 per cent higher than for the untreated leaves of the same plant. It is also interesting to note that the investigators express their confidence in the accuracy of the results obtained by the cobalt chloride method, which may now be regarded as a reliable method especially adapted to field use.

Not only are fungicides instrumental in increasing transpiration, but the fungi themselves may also act in a similar manner, as has been shown by WEAVER[10] for cereal rusts. Here the increase in transpiration occurs about the time the pustules break through the epidermis, and the amount of increase is closely related to the pustular area.

Experimenting upon the relations expressed in the comparison of the relative water loss from the plant and the atmometer, termed by LIVINGSTON "relative transpiration," KNIGHT[11] finds that this does eliminate the influence of changes of temperature and relative humidity on rate of transpiration. He asserts, however, that "relative transpiration" does not necessarily represent changes in the intrinsic transpiring power of a plant unless conditions of air movement are constant. This is because of the unequal response of plant and atmometer to changes in wind velocity.—GEO. D. FULLER.

[7] KNIGHT, R. C., The interrelations of stomatal aperture, leaf water-content, and transpiration rate. Ann. Botany **31**:221–240. 1917.

[8] MARTIN, W. H., Influence of Bordeaux mixture on the rates of transpiration from abscissed leaves and from potted plants. Jour. Agric. Research **7**:529–548. 1916.

[9] SHIVE, J. W., and MARTIN, W. H., The effect of surface films of Bordeaux mixture on the foliar transpiring power in tomato plants. Plant World **20**:67–86. 1917.

[10] WEAVER, J. E., The effect of certain rusts upon the transpiration of their hosts. Minn. Bot. Studies **4**:379–406. 1916.

[11] KNIGHT, R. C., "Relative transpiration" as a measure of the intrinsic transpiring power of the plant. Ann. Botany **31**:351–360. 1917.